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The Lepidoptera of White Sands National Monument, Otero County, New Mexico, USA 1. Two new species of Noctuidae (Lepidoptera, Noctuinae, Agrotini)

Eric H. Metzler [1,†], David Bustos [2,‡], Gregory S. Forbes [3,§]

1 *P.O. Box 45, Alamogordo, NM 88311-0045, USA* **2** *Resource Program Manager, White Sands National Monument, P.O. Box 1086, Holloman AFB, NM 88330, USA* **3** *Dept. Entomology, Plant Pathology, & Weed Science, Box 30003, MSC 3BE, New Mexico State University, Las Cruces, New Mexico 88003, USA*

† *urn:lsid:zoobank.org:author:BBF4EAD8-74F4-455D-B28E-EFA8015EC34C*
‡ *urn:lsid:zoobank.org:author:CB9A4000-A53C-45CA-86B7-7219395D195D*
§ *urn:lsid:zoobank.org:author:BA8A85BE-5E04-4649-8DC4-107A40CCA5A5*

Corresponding author: *Eric H. Metzler* (metzlere@msu.edu)

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Abstract

The white gypsum dune ecosystem in the Tularosa Basin in south central New Mexico is the largest gypsum dune field on earth, covering 712.25 km^2. White Sands National Monument in Otero County, New Mexico, protects approximately 40 %, 297.85 km^2, of this dune field. In 2006 the US National Park Service initiated a long term study of the Lepidoptera at White Sands National Monument, resulting in the discovery of two new species, *Euxoa lafontainei* Metzler & Forbes, **sp. n.** and *Protogygia whitesandsensis* Metzler & Forbes, **sp. n.** described herein. Adult moths and male and female genitalia are illustrated for *Euxoa lafontainei*, and adults and male genitalia are illustrated for *Protogygia whitesandsensis* and its relatives.

Keywords

Lepidoptera, Noctuidae, White Sands National Monument, Tularosa Basin, New Mexico, biological diversity, white gypsum dunes, National Park, Otero County

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Introduction

The North American species of the genus *Euxoa* Hübner, [1821] were revised by Lafontaine (1987), and the North American genus *Protogygia* McDunnough, [1929] was revised by Lafontaine and Fauske (2004). In 2007 and 2008 adults of *E. lafontainei* Metzler & G.S. Forbes, sp. n., and in 2007, 2008, and 2009, adults of *P. whitesandsensis* Metzler & G.S. Forbes, sp. n., were collected in the dune field at White Sands National Monument, Otero County, New Mexico. No specimens of either of these two species were known prior to the beginning of this study of insects at the Monument. The dearth of specimens of these two species, prior to this study, can probably be attributed to their occurrence in the gypsum dune ecosystem, which is under the jurisdiction of the US Department of Defense and the National Park Service.

Methods and materials

One hundred eighty two samples of moths and other night flying insects were collected in USDA-type black light traps and at black light and sheet (Covell 1984). All specimens of moths from the black light traps were retained. All non-lepidopterous insects from traps were placed in ethyl alcohol and deposited in New Mexico State University Arthropod Collection, Las Cruces, New Mexico (NMSU). Selected specimens of Lepidoptera and other insects, collected at black light and sheet, were pinned, spread, labeled, and identified, or frozen and retained for deposition in NMSU.

Genitalia were examined following procedures outlined in Clarke (1941), Hardwick (1950), and Lafontaine (2004). Abdomens were removed from the moths, wetted in 95 % ethyl alcohol, and soaked in 10 % KOH. Genitalia were dissected in 5 % ethyl alcohol, stained with Safranin O and Chlorazol Black in water, dehydrated in 100 % ethyl alcohol, cleared in oil of cloves, rinsed in xylene, and slide mounted in Canada balsam.

Terminology for wing pattern elements, morphology, and genital structures follows Forbes (1954) and Lafontaine (1987, 2004). Forewing lengths were measured to the nearest mm, using a stereo-microscope. Forewing measurements were from the base to the apex excluding fringe.

All specimens were collected as part of a long term study of Lepidoptera at White Sands National Monument. Specimens are deposited in the following collections: New Mexico State University Arthropod Collection, Las Cruces, New Mexico (NMSU); the Museum of Southwestern Biology, University of New Mexico, Albuquerque, New Mexico (MSWB); Albert J. Cook Arthropod Research Collection, Department of Entomology, Michigan State University, East Lansing, Michigan (MSU); Eric H. Metzler, Alamogordo, New Mexico, for subsequent transfer to MSU (EHM); Canadian National Collection, Ottawa, Ontario, Canada (CNC); McGuire Center for Lepidoptera and Biodiversity, University of Florida, Gainesville, Florida (UFL); Natural History

Museum, London, UK (BMNH); White Sands National Monument, New Mexico (WHSA); and specimens are provisionally deposited in National Museum of Natural History (Smithsonian Institution), Washington, DC (USNM) pending mutual resolution and agreement with the National Park Service regarding specimen deposition.

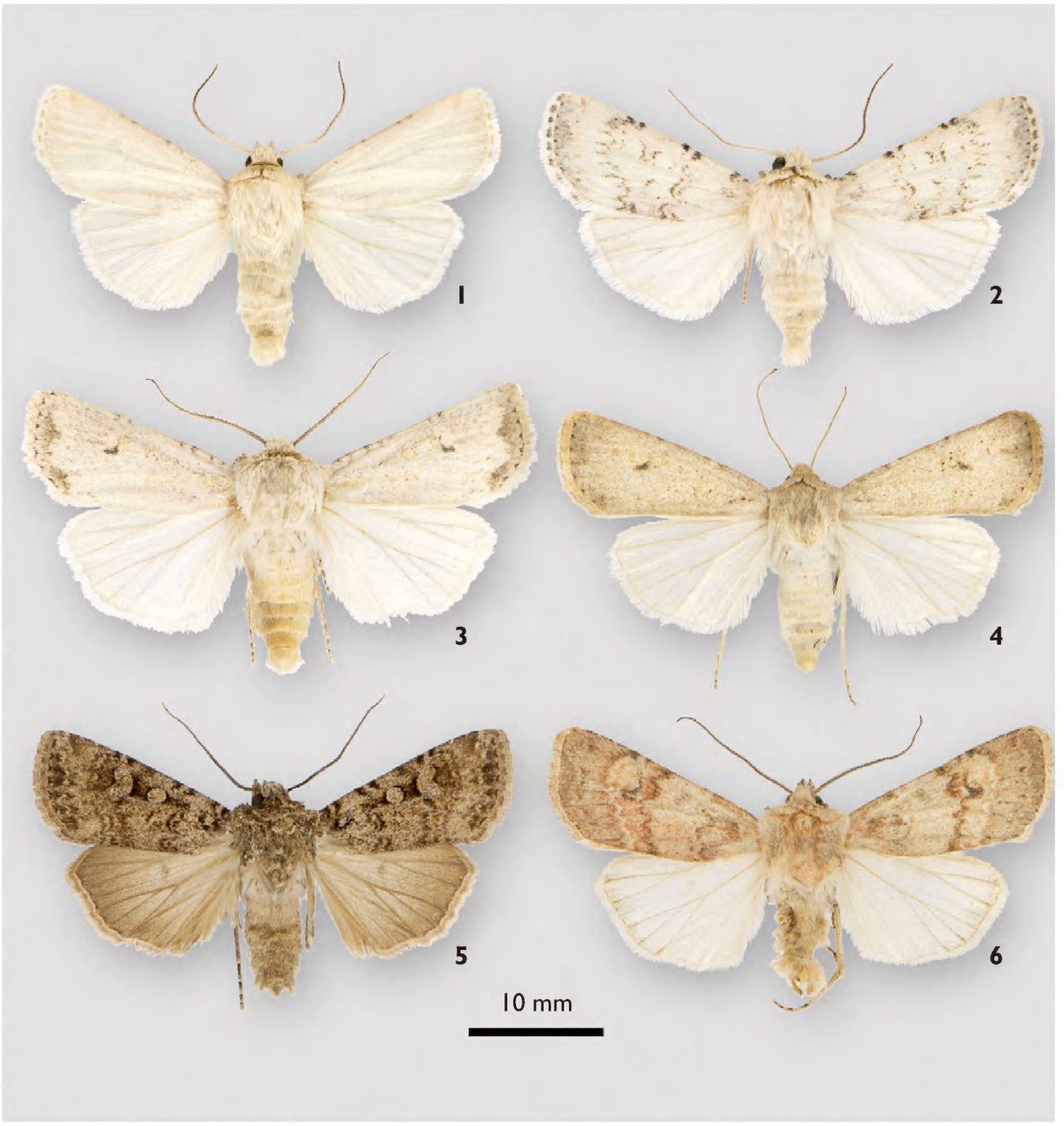
Plant names follow Martin and Hutchins (1981) and Sivinski (1994).

Results

***Euxoa lafontainei* Metzler & Forbes, sp. n.**
urn:lsid:zoobank.org:act:75E35369-23BC-4F23-AA1D-F44278BA8E4A
Figs. 1, 2, 7, 10, 19, 20

Type Material. Holotype: Male: USA: NM: Otero Co. White Sands Nat[ional] Mon[ument] interdunal/edge of dunes veg[etation] 106°11.32' W 32°45.72' W 4,000' 3 Jun 2008. WSNM9 Eric H. Metzler uv tr[a]p Accession #: WHSA – 00131. (USNM) **Paratypes**: 128 males and 46 females: USA, New Mexico: Otero County, White Sands National Monument (hereafter WSNM), 4004', 32°45'36.47" N 106°11'28.22" W, 11 Jun 2008, G. Forbes, interdune area with cottonwoods 2.3 mi SW Admin. Bldg., 15 w blacklight, Accession # WHSA – 00131. WSNM, Admin. Bldg., 4 Jun 2008, G. Forbes, Accession # WHSA – 00131. WSNM, 4006', storage area W of Big Pedestal Rd., 32°46'43.12" N 106°10'48.88" W, 26 Jun 2008, G. Forbes, 15w blacklight interdune area, Accession # WHSA – 00131. WSNM, 4006', storage area W of Big Pedestal Rd., 32°46'43.12" N 106°10'48.88" W, 30 May 2008, G. Forbes, 15w blacklight interdune area, Accession # WHSA – 00131. WSNM, 4002', ca 100 yards NE of end of Big Pedestal Rd., 32°45'43.62" N 106°11'18.73" W, 30 May 2008, G. Forbes, Baccharis grassland W side of rd., Accession # WHSA – 00131. WSNM, 3999', 32°46' 46.60" N 106°10' 26.70" W, 11 Jun 2007, G. Forbes, UV/MV lights Admin Bldg gypsum soil *Atriplex* scrub. Accession # WHSA – 00131. NM: Otero Co. WSNM 3999' 32 deg 46' 46.60" N. 106 deg 10' 26.70" W 18 May 2007 G.S. Forbes. admin. bldg. gypsum soil *Atriplex* scrub. Accession # WHSA 00131. WSNM, 4000' 32°45' 44.33" N 106°11' 19.51" W 22 Jun 2007 G. Forbes. Gypsum grassland at end Big Pedestal Road. Accession # WHSA 00131. NM: Otero Co. WSNM interdunal vegetation 106°11.49' W 32°45.60' N 4,000' 3 Jun 2008. WSNM8 Eric H. Metzler uv trp Accession # WHSA 00131. NM: Otero Co. WSNM edge of dunes/basin 106°11.24' W 32°45.70' N 4,001' 11 Jun 2007 WSNM3 Eric H. Metzler Accession # WHSA 00131. USA: NM: Otero Co. WSNM interdunal vegetation 32°45.57' N 4,006' 106°11.59' W 11 Jun 2007 WHSA2 Eric H. Metzler Accession # WHSA 00131. USA: NM: Otero Co. WSNM Edge of dunes veg. 106°11.32' W 32°45.72' N 4,000' 3 Jun 2008 WSNM9 Eric H. Metzler uv trp Accession # WHSA 00131. NM: Otero Co. WSNM dunes no vegetation 32°45.78' N 4,014' 106°11.49' W gypsum 13 May 2007 Eric H. Metzler WSNM1 Accession # WHSA 00131. NM: Otero Co. WSNM edge of dunes veg 106°11.32' W 32°45.72'

N 4,000' 3 Jun 2008 WSNM8 Eric H. Metzler uv trp Accession # WHSA 00131. NM: Otero Co. WSNM edge of dunes veg 106°11.32' W 32°45.72' N 4,000' 22 Jul 2008 WSNM8 Eric H. Metzler uv trp Accession # WHSA 00131. USA: NM: Otero Co. WSNM interdunal vegetation 32°45.57' N 4,006' 106°11.59' W 13 May 2007 WHSA2 Eric H. Metzler Accession # WHSA 00131. USA: NM: Otero Co. WSNM interdunal vegetation 106°11.49' W 32°45.60' N 4,000' 3 Jun 2008 WSNMB Eric H. Metzler uv trp Accession # WHSA 00131. USA: NM: Otero Co. WSNM dunes crest vegetation 106°11.42' W 32°45.67' N 4,014' 3 Jun 2008 WSNMC Eric H. Metzler uv trp Accession # WHSA 00131. USA: NM: Otero Co. WSNM edge of dunes/basin 32°45.70' N 4,001' 106°11.24' W 13 May 2007 WHSA3 Eric H. Metzler Accession



Figures 1-6. Adults of *Euxoa* species. **1**. *E. lafontainei,* male paratype. **2**. *E. lafontainei,* male paratype. **3**. *E. misturata,* male. **4**. *E. tronellus,* female. **5**. *E. simulata,* male. **6**. *E. medialis,* male.

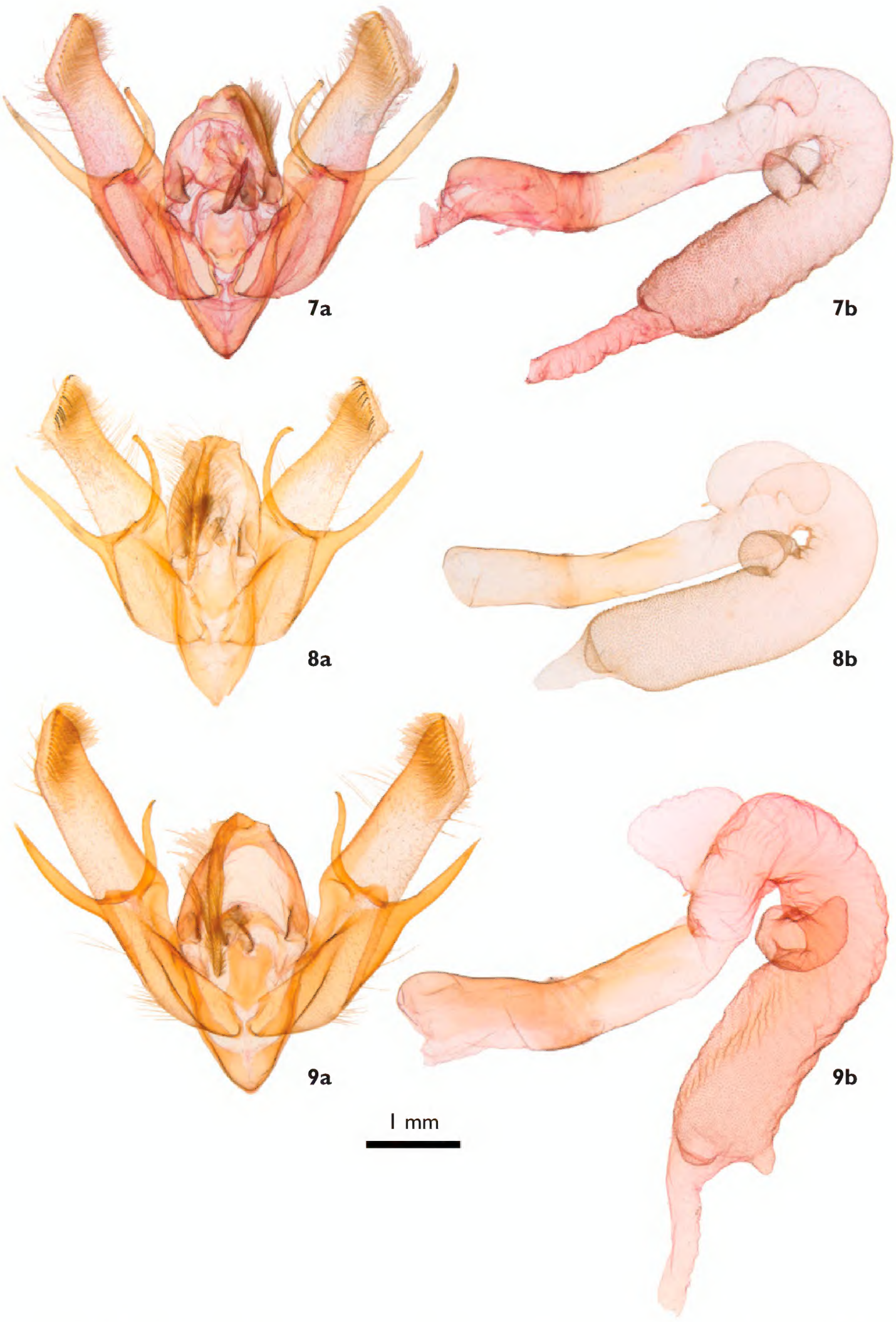
WHSA 00131. USA: NM: Otero Co. WSNM 106°11.39' W 32°45.78' N 4014' 13 May 2007 Eric H. Metzler Accession # WHSA 00131. USA: NM: Otero Co. WSNM 106°11.59' W 32°45.57' N 4006' 11 Jun 2007 Eric H. Metzler Accession # WHSA 00131. Paratypes are deposited with NMSU, MSWB, MSU, EHM, UFL, CNC, BMNH, USNM, and WHSA.

Etymology. The specific epithet of this species, *lafontainei*, recognizes J. Donald Lafontaine's contributions to the study of *Euxoa*. Don Lafontaine and Eric Metzler share a personal friendship going back to the late 1960s. We are pleased to name this species for Don Lafontaine.

Diagnosis. *Euxoa lafontainei* is a silky white moth. Some specimens are pure white whereas others show faint pale-gray traces of normal transverse noctuid markings. A few specimens have pale gray normal markings on a white ground color. A combination of four characteristics quickly distinguish *Euxoa lafontainei* from other species of *Euxoa:* 1) both sexes with reflective white forewings; 30 % of males (n =104) and 42 % of females (n = 26) have traces of faint pale gray normal transverse noctuid markings; 2) pure white hind wings; 3) adults fly in May, June, and July in the gypsum dune field in the Tularosa Basin of south central New Mexico; 4) the characters of the male genitalia place *E. lafontainei* in the subgenus *Euxoa.* Other species of *Euxoa* that fly in the dunes, *E. misturata* (Smith, 1890) and *E. tronellus* (Smith, 1903), are both pale colored moths; *E. misturata* (Fig. 3) has pale gray markings, and *E. tronellus* (Fig. 4) is pale tan. *Euxoa misturata* and *E. tronellus* have more or less obvious reniform spots and dark gray in the subterminal area. Male genitalia are most like those of *E. simulata* McDunnough, 1946 (Figs. 5, 8, 11), and female genitalia are most like *E. medialis* (Smith, [1888]) (Figs. 6, 9, 12). The adults of *E. simulata* and *E. medialis* are dark in color.

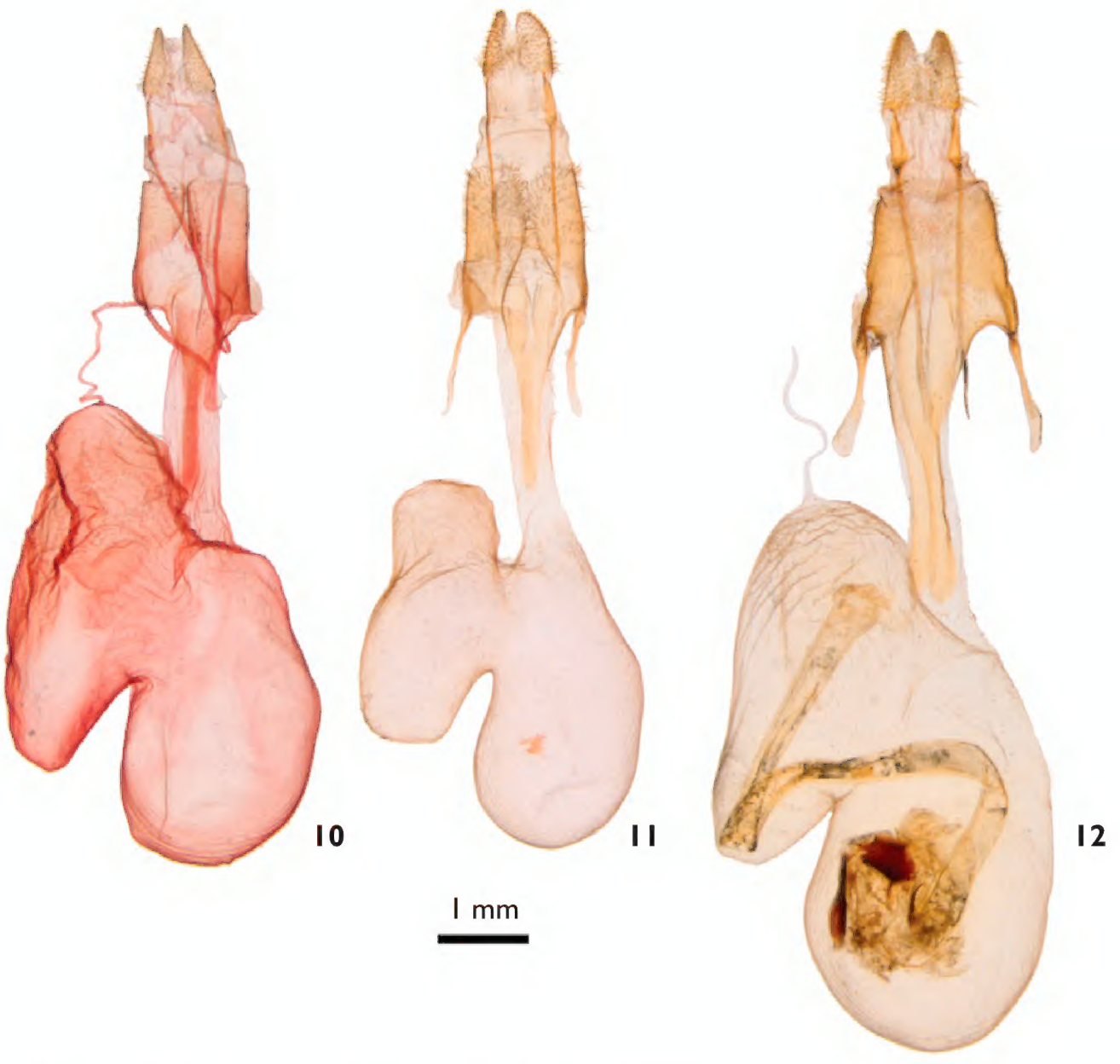
In the *Euxoa* species key of Lafontaine (1987), *E. lafontainei* males key out to couplet 31, which gives a choice of right saccular extension 1.25 × longer than left one, versus right saccular extension less than 1.25 × as long as left one. In *E. lafontainei* the right saccular extension is 1.25 × the length of the left one, so both couplets 32 and 34 must be followed. Couplet 32 gives two options, neither of which could apply to the new species, so following couplet 34 is evident. *Euxoa lafontainei* then keys out to the *Euxoa simulata* group in couplet 46 and the group only includes *Euxoa simulata*. *Euxoa lafontainei* differs from *E. simulata* in the color of the adults. Females of *E. lafontainei* key out to the *E. bostoniensis* (Grote, 1874) group and not the *E. simulata* group because of the fine-tipped setae on the anal papillae. Within the *E. bostoniensis* group *E. lafontainei* keys out to *E. medialis,* but differs from *E. medialis* in the color of the adults.

Description. Adult male (Fig. 1, 2): **Head** – frons rough, front closely scaled, white; vertex scales narrow strap-like, white, erect; labial palpus white; basal and medial segments with erect hair-like and strap-like scales, closely scaled laterally and mesally, longer scales form longer ragged fringe ventrally and shorter ragged fringe dorsally; apical segment angled anteriorly, closely scaled; haustellum coiled between labial palpi with more than four complete loops; antenna biserrate, dorsally white, closely scaled,



Figures 7-9. Male genitalia of *Euxoa* species: a-valves, b-aedeagus with vesica everted. **7**. *E. lafontainei* paratype. **8**. *E. simulata*. **9**. *E. medialis*.

ventrally naked, brown. **Thorax** – dorsum white, scales long white (rarely tipped with gray) hair-like or deeply forked apically, underside white, scales erect long white hair-like. Legs: coxa and femur white, closely scaled with long hair-like scales on ventral surface forming a shaggy fringe; fore tibia white, closely scaled, with stout setae on lateral margins; mid – and hind tibia white, closely scaled, shaggy long hair-like scales basally, tibial spurs white; tarsomeres dirty white. Fore wing: length 13-15 mm, mean 14 mm, n = 8. ground color white, reflective, normal noctuid transverse lines and spots usually absent; some specimens with scattered gray scales (Fig. 2), rarely the gray scaling complete enough to form normal noctuid transverse lines, spots, and fringe; subterminal and terminal areas dirty white; fringe shining white, occasionally with gray and dirty white scales; underside white with dirty white costa; fringe shining white. Hind wing: white, reflective, terminal area dirty white, veins lined with dirty white scales; fringe white; underside white, terminal area dirty white, veins lined with dirty white scales; fringe white. **Abdomen** – dorsum closely scaled, white, overlaid with long shaggy hair-like scales, white to dirty white; underside closely scaled, white. **Genitalia** (Fig. 7)



Figures 10-12. Female genitalia of *Euxoa* species. **10**. *E. lafontainei* paratype. **11**. *E. simulata.* **12**. *E. medialis.*

– tegumen not expanded laterally, lateral lobes at junctures with valvae, narrowed at dorsum; uncus cylindrical, narrowed at base, slightly wider from 1/5 length to 3/4 length, setae on dorsum at widest part, long and dense; preapical setae on ventral surface short, stout, cylindrical; saccus V shaped, slightly longer than wide; juxta oval, narrowly cleft from posterior margin; valve strap-like, costal margin slightly longer that ventral margin; saccular extension on right side 1.25 × length of saccular extension on left side; saccular extensions directed down and away from cucullus; clasper (harpe) slightly flattened distally, lightly setose, C shaped; corona well differentiated, 16-19 stout setae in a single row, directed basad. Aedeagus slightly bent at mid-point, 4-5 × as long as wide; vesica lightly sclerotized, at 1/3 length from aedeagus curved right 90°, subbasal and medial diverticula present.

Adult female – similar to male; fore wing: length 13-17 mm, mean 15 mm, n = 24. Antenna filiform. **Genitalia** (Fig. 10) – papilla analis sclerotized, cylindrical, conical, setae on distal 1/3 progressively shorter apically, apex bluntly rounded, not fused; posterior apophysis extending anteriorly to anterior margin of 8th abdominal segment; anterior apophysis shorter, extending to anterior margin of 8th abdominal segment, slightly bent, apically flattened; ostium bursae lightly sclerotized; plates in dorsal and ventral walls of ductus bursa sclerotized, extending from ostium bursae anteriorly to 2/3 length, straight; bursa copulatrix bisaccate, membranous; corpus bursa extended to right, 2 × as long as maximum width, signa absent; appendix bursae extended ventrolaterally to left, size and shape similar to corpus bursa; ductus seminalis attached near ventral posterior end.

Remarks. This new species is placed in the genus *Euxoa* based on the structure of the male and female genitalia. The characters of the male genitalia place *E. lafontainei* in the subgenus *Euxoa* and in the *E. simulata* species-group.

Distribution and Biology. *Euxoa lafontainei* occurs in White Sands National Monument, Otero County, New Mexico (Figs. 19, 20). Adults were collected in black light traps and at a sheet with a black light and/or mercury vapor light placed in the white gypsum dunes, interdunal areas, and at the Administration Building. The immature stages are unknown.

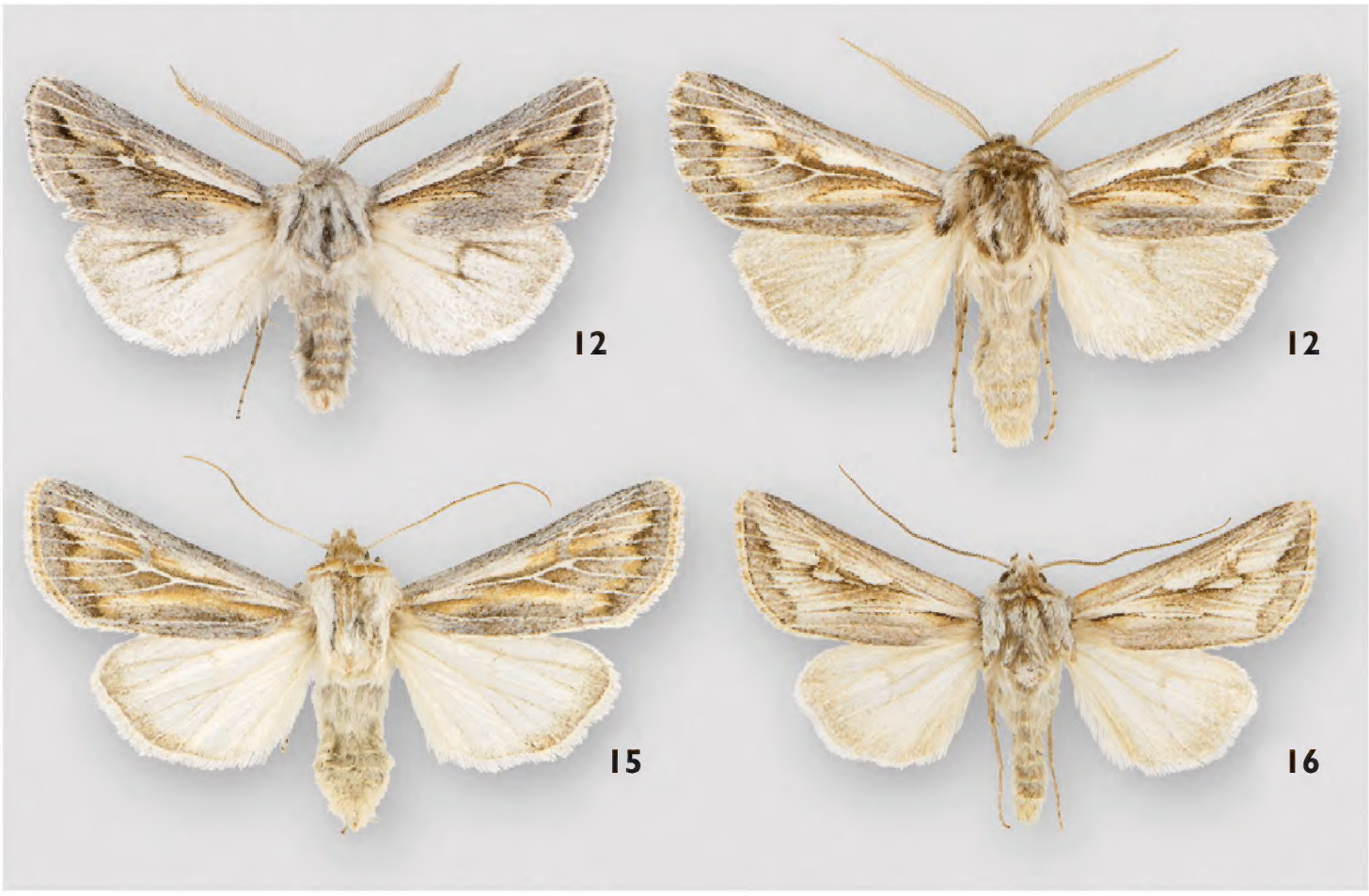
Protogygia whitesandsensis **Metzler & Forbes, sp. n.**
urn:lsid:zoobank.org:act:21257498-EAF1-4AF5-9357-A3CF6A6FE47E
Figs. 13, 17, 19, 20

Type material. Holotype: Male: USA: NM: Otero Co. White Sands Nat[ional] Mon[ument] interdunal vegetation 32°46.62' N 106°10.82' W 4,008' 26 February 2009 Eric H. Metzler WHSAD uv tr[a]p Accession #: WHSA – 00131. (USNM). **Paratypes**: 18 males as follows: USA, NM: Otero County, White Sands National Monument (hereafter WSNM), interdunal vegetation 106°11.49' W 4,000' 32°45.60' N 15 Mar 2008 WSNMB Eric H. Metzler uv trp Accession # WHSA 00131. WSNM, interdunal vegetation, 32°45.57' N 4,000' 106°11.59' W gypsum 12 Mar 2007

WHSA2 Eric H. Metzler Accession # WHSA 00131. WSNM, interdunal vegetation 32°46.62' N 106°10.82' W 4,008' 26 Feb 2009 Eric H. Metzler WHSAD uv trp Accession #: WHSA – 00131. WSNM, interdunal vegetation 106°11.59' W 32°45.57' N 4006' 15 Mar 2008 uv trp WSNM2 Eric H. Metzler Accession # WHSA – 00131. WSNM, interdunal vegetation 106°11.33' W 32°45.5' N 4004' uv trp 6 Apr 2008 Eric H. Metzler WSNMA Accession # WHSA – 00131. WSNM, edge of dunes vegetation 32°45.72' N 106°11.32' W 4,000' WSNM9 26 Feb 2009 uv trp Eric H. Metzler Accession # WHSA – 00131. WSNM, interdunal vegetation 32°45.60' N 106°11.49' W 4,000' 26 Feb 2009 Eric H. Metzler uv trp WSNMB Accession # WHSA – 00131. WSNM, 106°11.59' W 32°45.57' N 4006' 12 Mar 2008 WSNM2 Eric H. Metzler Accesn # WHSA – 00131. Paratypes are deposited in NMSU, MSWB, MSU, EHM, CNC, USNM, and WHSA.

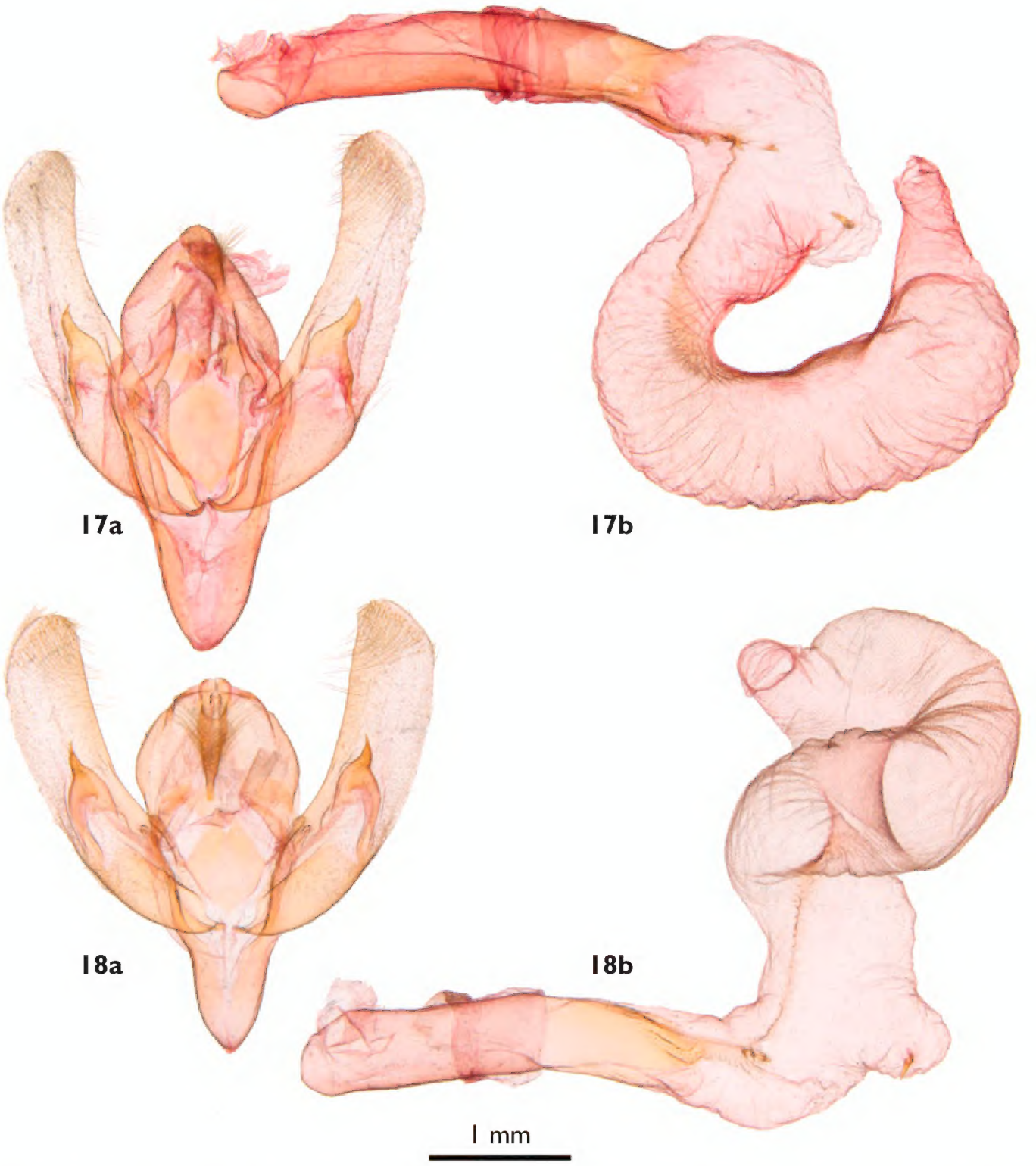
Etymology. The specific epithet of this species, *whitesandsensis* (-ensis is a Latin suffix denoting "place, locality") identifies the white gypsum dunes at White Sands National Monument as the type locality. The name recognizes the importance of White Sands National Monument for its unique ecosystem and accompanying biota.

Diagnosis. *Protogygia whitesandsensis* is a pale silvery-gray moth without most normal transverse noctuid markings and spots. A combination of 6 characteristics distinguish *Protogygia whitesandsensis* from other species of *Protogygia*: 1) pectinations of male antenna are 9.6 × width of antenna whereas pectinations of male antenna of *P. pectinata* Lafontaine, 2004 (Fig. 14) are 7 × width of antenna; those of *P. biclavis*



Figures 13-16. Adults of *Protogygia* species. **13**. *P. whitesandsensis* male paratype. **14**. *P. pectinata*, male **15**. *P. comstocki*, female. **16**. *P. biclavis, male.*

(Grote, 1879) (Fig. 16) are 2 × width of antenna; those of *P. comstocki* McDunnough, 1934 (Fig. 15) are 1.5 × width of antenna; 2) fore wing color pale silvery gray; 3) fore wing with dark and white streaks from the base to the medial area, postmedial area, and outer margin; basal dashes of *P. pectinata*, *P. comstocki* and *P. biclavis* extend to antemedial area; 4) forewing with a prominent white shade in the cell between the base and the reniform spot; 5) adults fly in February and March in the gypsum dunes in the Tularosa Basin of south central New Mexico; 6) adults most closely resemble *P. pectinata*. The colors of *P. whitesandsensis* are more gray and muted than *P. pectinata*. The colors of *P. pectinata* are more brown and contrasting than *P. whitesandsensis*.



Figures 17-18. Male genitalia of *Protogygia* species: a-valves, b-aedeagus with vesica everted. **17**. *P. whitesandsensis*, paratype. **18**. *P. pectinata*.

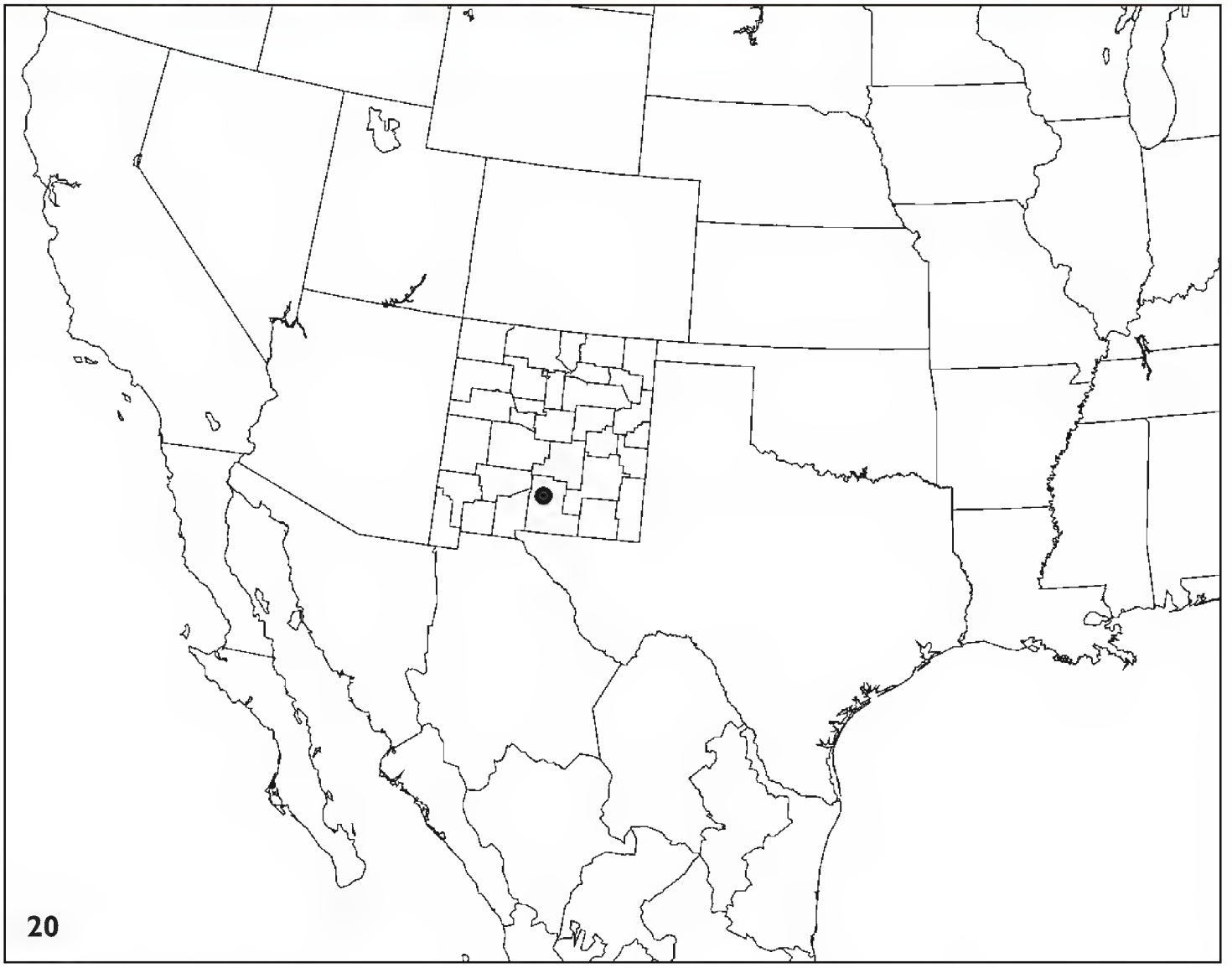
In Lafontaine and Fauske (2004) this species easily keys out to *P. pectinata*, but *P. whitesandsensis* has wider antennae, less orange on the forewing, less contrasting veins, and a different distribution.

Description. Adult male (Fig. 13): **Head** – vertex, narrow and narrow hair-like scales, white, occasional black scales, erect; front, narrow hair-like scales, white, a narrow band of scales across the front between the eyes, black, hair-like; labial palpus white with black scales, blackened laterally; basal and medial segments erect, hair-like scales, shaggy; apical segment angled anteriorly, closely scaled dorsally and anteriorly, white; haustellum coiled between labial palpi with more than four complete loops; antenna broadly bipectinate, dorsally white, scattered black scales, pectinations and ventral surface naked, dark brown. **Thorax** – color white, scattered black scales; tegula white, scattered black scales, laterally and mesally lined with black; dorsum white, scattered black scales, mid-dorsal black stripe; underside white, mixed with black scales, hair-like, long erect, shaggy appearance. Legs: coxa and femur white mixed with black giving a dirty appearance, closely scaled with long hair-like scales on ventral surface forming a shaggy fringe, fore tibia and mid-tibia black terminus, tarsomeres similarly white with black scales, each tarsomere terminus ringed with black. Fore wing: length 14-17 mm, mean 15.2 mm, n = 14. pale silvery gray; basal line, antemedial line, medial shade, postmedial line, claviform spot, and orbicular spot absent; prominent sub costal white shade in cell from base to reniform spot; basal dash, 3 elements, black, prominent, from base to reniform spot, white, not prominent, from base to medial area, black, not prominent, from base to antemedial area; subterminal line black, contrasting, zig zag from costa to inner margin; radial, medial, cubital, and anal veins lined with white; reniform lower and upper lobes lined with white; terminal line vaguely white; fringe, base marked with black scales, otherwise white; underside pale silvery gray, dusky shade in cell, veins variously lined with white, fringe concolorous. Hind wing: pale gray; veins variously lined with white or darker gray scales; discal spot dark gray; fringe, base concolorous, outer half white; underside concolorous; discal spot absent; fringe concolorous. **Abdomen** – dorsum light gray mixed with black scales, closely scaled, overlaid with long hair-like scales; underside of segments 3, 4, and 5 black and white contrasting, gray elsewhere with admixture of black scales. **Genitalia** (Fig. 17) – tegumen widened laterally, narrowed dorsally; uncus widened mesally, abruptly down-turned and pointed apically, long hairs dorsally; vinculum V shaped; valve strap-like slightly wider in saccular area, apex with dense setae, directed basad on mesial surface; clavus length 3 × width; clasper sinuous, tear drop shaped, ending in drawn-out point apically; aedeagus slightly bent at middle; vesica bent to right, base of vesica with 6 or 7 stout setae; subbasal diverticulum short with one stout terminal seta.

Adult female: unknown.

Remarks. This new species is placed in the genus *Protogygia* based on the male genitalia, and the adult male's close resemblance to *P. pectinata*.

Distribution and biology. *Protogygia whitesandsensis* occurs in White Sands National Monument, Otero County, New Mexico (Figs. 19, 20). Adults were collected in black light traps placed within the gypsum dunes. Females and the immature stages are unknown.



Figures 19-20. 19. White dunes habitat of type locality of *Euxoa lafontainei* and *Protogygia whitesandsensis*. **20**. Distribution map for *Euxoa lafontainei* and *Protogygia whitesandsensis*.

Discussion

In 2006 the US National Park Service invited Metzler to initiate a long term study of the Lepidoptera at White Sands National Monument, Otero County, New Mexico. A primary purpose of the study was to compile an inventory of moths in habitats within and immediately adjacent to the white gypsum dunes in the Monument. This is the first in a series of papers pertinent to a detailed study of the Lepidoptera at White Sands National Monument.

White Sands National Monument preserves 297.85 km^2 (275 square miles), or about 40 %, of the world's largest white gypsum dune field. The dune field is located in the northern Chihuahuan Desert in southern New Mexico's Tularosa Basin (Schneider-Hector 1993). The dunes were created from dissolved gypsum crystals originating in large playa lakes at the southwestern boundary of the dune field. As water evaporates from the water surface gypsum crystallizes out of solution and forms on the dry surface of the playa. As the crystals disintegrate sand-sized crystals are formed. Winds, predominately from the southwest, blow the sand-sized crystals from the dry lake bed or lake edge onto the dune field. The dunes can be as high as 10 m. Plants and soils are successively covered and uncovered as the blowing sand moves the ridge crests from the southwest to the northeast as much as 9 m per year (McKee and Moiola 1975).

Plants respond to the harsh conditions of shifting pure gypsum soils in several ways. They add stem length rapidly to accommodate encroaching dunes, they send out rhizomes (lateral roots) so new shoots can sprout up 10 to 20 meters away from the original plant, and they form large gypsum pedestals (two to three meters high) as dunes pass by providing support for the 3 meter high root system that formed as they grew to avoid being taken over by a passing dune. Common examples of plants exhibiting these adaptations at the Monument are *Yucca elata* Engelm. (Agaveaceae), *Rhus trilobata* Nutt. (Anacardiaceae), *Poliomintha incana* (Torr.) Gray (Lamiaceae), and *Populus fremontii* var. *wislizenii* Wats. (Salicaceae).

There are several common gypsophilous plants which are very faithful to gypsum habitats and will always indicate gypseous soils when found in the field. The New Mexico gypsum flora is often dominated by *Tiquilia hispidissima* (Torr. & Gray) A. Richards (Boraginaceae), *Sporobolus nealleyi* Vasey (Poaceae), *Bouteloua breviseta* Vasey (Poaceae), *Nerisyrenia linearifolia* (S. Watson) Greene (Brassicaceae), and *Calylophus hartwegii filifolius* (Eastw.) Towner & Raven (Onagraceae). Other common, but less abundant, species include *Anulocaulis gypsogenus* Waterfall (Nyctaginaceae), *Selinocarpus lanceolatus* Woot.(Nyctaginaceae), *Nama carnosum* (Woot.) C.L. Hitchc. (Hydrophyllaceae), *Dicranocarpus parviflorus* Gray (Asteraceae), and *Centaurium maryannum* B.L. Turner (Gentianaceae) (Sivinski 1994).

At first glance much of the white gypsum dunes may appear bleak and devoid of animal life, but a closer look reveals seven subspecies that are endemic to the white sands. These animals are specifically adapted to life in the white dunes by their permanently white color, or apparent lack of color. These are *Holbrookia maculata ruthveni*

Smith, 1943 (Squamata), *Sceloporus undulatus cowlesi* Lowe & Norris, 1956 (Squamata), *Cnemidophrus inornatus gypsi* Wright & Lowe, 1993 (Squamata), *Perognathus flavescens apache* Merriam, 1889 (Rodentia), *Neotoma nicropus leucophaea* Baird, 1855 (Rodentia), *Ammobaenites phrixocnemoides arenicolus* (Strohecker, 1947) (Orthoptera), and *Daihinoides hastiferum larvale* (Strohecker, 1947) (Orthoptera). At least four species are variable in color, but individuals collected on the white substrate at the Monument are pale, when compared to nearby populations that do not live in the dunes. These animals are *Spermophilus spilosoma* Bennett, 1833 (Rodentia), *Cibolecris parviceps arida* (Brunner, 1889) (Orthoptera), *Phrynosoma cornutum* (Harlan, 1825) (Squamata) (Kain 2000) and *Copablepharon serratigrande* Lafontaine, 2004 (Lepidoptera). Animals that are naturally white, or pale in color else where may reside at White Sands to take advantage of the white sands substrate include *Olla v-nigrum* (Mulsand, 1866) (Coleoptera), and animals maintain their pigment but use elements of the environment or secrete a waxy substance to appear white and blend into the substrate such as a lycosid spider (Araneida) (Bugbee 1942).

There is a dearth of research on the invertebrate fauna in the gypsum dune field in the Tularosa Basin of New Mexico. Highlights of past research at White Sands National Monument pertinent to insects are Stroud (1950) who listed 452 species of insects and Strohecker (1947) who described 2 species of colorless camel crickets endemic in the gypsum dunes.

In 1950 Stroud reported 20 species of Lepidoptera from the Monument. In the period 9 February 2007 through 31 December 2008 Metzler and Forbes identified more than 300 species of Lepidoptera (unpublished data) from the Monument. Because of the unusual physical and biological qualities of the New Mexico white gypsum dunes, we were especially aware of the possibility of finding undescribed species of moths. The white color of the two new species described herein is consistent with the color of animals endemic to the study area. The study of Lepidoptera at White Sands National Monument is projected to last approximately ten years.

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ment Resource Program Manager Diane White recommended and Superintendent Cliff Spencer approved the study for 2007. The National Park Service renewed the study for 2008 and 2009. Superintendent Kevin R. Schneider was enthusiastic in continuing the support of the National Park Service. Robert D. Barber and Steven J. Cary offered important comments and contributed data on butterflies they observed at the Monument. Representatives from research collections provided insect pins, alcohol, identification services, research consultation, and storage space for specimens collected. We thank the following persons for offering support from their respective institutions: David B. Richman (NMSU) Kelly B. Miller, Sandra L. Brantley, and David C. Lightfoot (MSWB), Frederick W. Stehr, Anthony I. Cognato, Gary L. Parsons, and Richard W. Merritt (MSU), Charles V. Covell, Jr., Jacqueline Y. Miller, and Thomas C. Emmel (UFL), J. Donald Lafontaine (CNC), Larry Berger Ohio Department of Agriculture, and David G. Furth (USNM). Patricia A. Metzler faithfully accompanied Metzler on his many collecting trips to the Monument, and she accompanied him on several long driving trips to Washington, DC and New York City, New York for the purpose of identifying specimens. She contributed financially to the study. We thank David L. Anderson for comments on botanical aspects of the paper. We thank Steven J. Cary, J. Donald Lafontaine, and B. Christian Schmidt for reviewing the manuscript and offering valuable suggestions.

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